short to allow the evolution of the Cambrian fauna.

found in the Cambrian of low organisms up to the complex animals strata. That development was at least half of the evolution process from the amoeba to man.

The origin of life is not within the scope of this writing.

COMMENT

In the above comparison, which is intended to be fair and impartial, the reader will find only one item in which the nebular view might be held superior in its explanation of the earth's features and structure. That is number five, concerning the excessive density of the earth's core. Most of the topics, especially after number eight, are decidedly unfavorable to the nebular view.

HERMAN L. FAIRCHILD
UNIVERSITY OF ROCHESTER

ON THE SIGNIFICANCE OF SCIENCE[1]

Honored Members of the Twelfth Congress on Physiology,

Ladies and Gentlemen:

THE chancellor of the Swedish universities has been prevented by indisposition from being their spokesman on this memorable occasion. Charged with the duties of the chancellor I have been bound to enter into his place. Certainly all of us regret, as much as Dr. Swartz, that he can not realize to-day his keen desire to speak here. We wish him rapid progress in his convalescence. In accordance with his request I transfer to all of you, ladies and gentlemen, his sincere greetings.

Thus it is my most agreeable privilege to express on behalf of the Swedish universities and Swedish research our common joy and pride in receiving in our country so many renowned investigators of the human organism and its functions. To our hearty welcome we add the wish and the hope that your stay in our capital may be fruitful for your high scientific task and pleasant and recreative for each and every one of you.

It was said during and after the world war that if science appeared in the Council of Nations it ought to adorn itself with a bloody vestment, since it served and multiplied destruction everywhere. In large groups of our generation a dire lesson has changed idolatry of science into depreciation of it.

Is science then morally indifferent, so that it can serve death as well as life, the devil as well as God? The problem is not as simple as one might think. In any case there is a moral element in all genuine research. For it belongs to the nobility and sanctity of science to be faithful to its own inmost self. Science must be treated as master, not as servant. It can not without detriment to its purity and success be made ancillary to ready-made dogmatics or wishes. "Naturae non imperatur nisi parendo." It follows its own law. Therefore it requires of the investigator not only labor and perseverance, acuteness of mind and essential imagination, but it requires also self-discipline, subordination of the own ego to higher aims, and conscientiousness and a sincere striving to discover the real connection and character of things and organisms. Therefore, research gives in normal cases to men a stamp of earnestness and truth. A closer investigation will show that deficiency in the moral character must sooner or later have an unfavorable effect on research and its results, at least in important and delicate tasks.

The primitive peoples practice what they call white and black magic, that is sorcery which is used in furtherance of life and sorcery which is used with evil intent. They are right in condemning the latter kind of the primitive science and technic, which we call magic. In the same way modern science must not be used for unworthy purposes. It is a degradation of research to be made subservient to private and collective egoism, to the detriment of mankind.

When science is underrated, one forgets its rôle of furthering life and humanity. During the world catastrophe science exhibited, if possible, still more self-sacrificing zeal and still more genius than ever before, in helping charity to heal and cure, to soothe and comfort. You, gentlemen, are benefactors of humanity, because you represent with honor the art of healing. That redoubles the joy we feel that your international scientific gathering has chosen to meet in the capital of Sweden.

If we consider the relation between science and practical purposes we find a seeming contradiction.

The aim of medical research is practical: to help and strengthen life. Also outside medicine an investigator can be inspired by a conscious practical goal, and that increases his humanity if the goal is good. But the remarkable thing is that the usefulness of science to human life and civilization is not accomplished through any practical aim. It belongs to the secret of science that it serves the practical needs of life best in working with a purely theoretical view. The desire to know carries research out into unknown

[1] Welcome to the Twelfth International Congress of Physiology meeting at Upsala by the pro-chancellor of the University of Upsala and the Archbishop of Upsala.

tracts, its advances led only by its method. Here a contradiction appears, which is apt to give occasion to reflection and which lets us perhaps surmise or even perceive a greater personal and spiritual connection, which is not accessible to science as such. I mean that seeming contradiction, that research proves to be most practical when it is purely theoretical. Science has made many of its greatest conquests when, impelled by its own genius, it has said, not: I want to accomplish, I want to rule, but only I want to know. Saul, the son of Kish, went out in his daily business and sought after his father's asses, but he found a royal crown. In the same way science does not always know where it will arrive. But advancing with unswerving faithfulness to its own principles and with an unselfish, exalted desire to widen the limits of knowledge, advancing in severe self-discipline and self-forgetfulness it attains to ends exceeding abundantly all that it could hope or think.

It belongs to the proud charter of science to be itself and to obey its own law. But when science is faithful to itself and works without by-designs, it gains a still greater glory than knowledge and its own inviolate independence. It proves to be a servant of life. No quality of research is more wonderful. When a discovery has been made through the sole unprejudiced desire to know, it appears that life and humanity profit by it in a way that is most unexpected—perhaps epoch-making.

Therefore I greet you as knights of science and as servants of life, and I wish you continued success in your high calling.

NATHAN YODERBLOM

THE UNIVERSITY OF UPSALA

SCIENTIFIC EVENTS

WIRELESS RESEARCH IN ENGLAND

ACCORDING to an article in the London *Times* the wireless division of the National Physical Laboratory at Teddington continues to make good progress with the several and varied problems which are submitted to it for solution by the Radio Research Board. For several years past a comprehensive investigation has been carried out on the mode of propagation of wireless waves over the earth's surface, and for this purpose apparatus has been developed for the accurate simultaneous measurement of both the intensity and direction of arriving wireless waves. This work has recently led to some most successful demonstrations of the existence of an upper ionized layer at the top of the earth's atmosphere, which serves to deflect wireless waves reaching it and to return them to the earth's surface. By taking account of the combination of these downcoming waves with those transmitted straight along the earth's surface, an explanation can be given of all the phenomena of fading of wireless signals and the erratic behavior of wireless direction finders when the transmission is over any but the shortest distances. In a similar manner the influence of the atmosphere can be shown to account for the wonderful results which have been obtained by both amateur and professional workers in transmitting over very long distances with short waves. In this connection it may be noted that a small frame aerial receiving sets with only two valves has been used at the laboratory for the reception of signals on short wave-lengths from a small ship's transmitter at a distance of over 7,000 miles. These investigations are being continued as a means of obtaining further knowledge about the parts of the upper atmosphere which are beyond the reach of the direct observations employed in meteorology.

Another portion of the wireless work of the laboratory concerns the complete study of the behavior of valve amplifiers for use in receivers used for broadcasting and general purposes. For this purpose a somewhat elaborate equipment has been built up, using the most modern measuring apparatus, for testing the effective magnification given by valve amplifiers as well as the amount of distortion which they may introduce when used for the reproduction of speech and music. A feature of this equipment, to which the staff of the laboratory have devoted a great deal of attention, is the manner in which portions of the apparatus are shielded by metal plates and wire gauze from the effects of stray electric and magnetic fields, which would seriously detract from the accuracy of the measurements. In one case a whole room has been completely lined with galvanized iron wire netting of small mesh to protect the apparatus within from these stray effects.

In addition to research on wireless receivers a certain amount of work is carried out in connection with wireless transmitters. The major portion of such work is confined to the use of special forms of transmission to meet the needs of other investigations. Also, by the aid of its standard wave meter for the measurement of wave-length or frequency, the laboratory continues to maintain a regular program of the transmission of standard waves of accurately adjusted length or frequency, by means of which any listener within range may calibrate a wave meter or receiver.

In order to keep pace with the rapid development which is taking place in the science and practice of wireless communication, the staff of the National Physical Laboratory has found it necessary to acquire a detailed knowledge of the technique applying to a very large range of wave-lengths. On account of the